

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 28.—“On the Theory of Refraction in Gases.” By George W. **Walker**, M.A., A.R.C.Sc., Fellow of Trinity College, Cambridge. Communicated by Prof. J. J. Thomson, F.R.S.

The present theories of refraction in gases lead to the formula $\mu^2 - 1 = Nf(p)$, where N is the number of molecules per unit volume, and $f(p)$ is a function of the frequencies of the waves and independent of temperature. The measured variation of μ with temperature does not agree with this formula. There are several cases where $\mu^2 - 1$ is much less than $K - 1$, where K is the dielectric constant, and in such cases we find that, although $\mu^2 - 1$ is approximately proportional to N , $K - 1$ is nearly proportional to N/θ , where θ is the absolute temperature.

The present theories are thus inadequate to explain the actual facts.

The view adopted in the present paper is that instead of having free periods of vibrations, the molecules move in constrained motion. Regarding the atom as consisting of a positively charged particle united with a large number of small negatively charged particles, it is supposed that the negative particles roll on the surface of the positive one, but do not vibrate radially. The control on transmitted waves is thus the rotational energy of motion of the particles, and it must be proportional to the absolute temperature.

When, by collisions or otherwise, the rotational motion becomes so great that the electric attraction is overcome by the centrifugal force, ionisation occurs. The frequency or frequencies of rotation at which this occurs are determined by the electrical attractions, and are independent of temperature, although, of course, the higher the temperature the greater will be the amount of ionisation. These frequencies are regarded as corresponding to the spectral lines; this view explains the ionisation produced by ultra-violet light, and also agrees with the fact that luminosity is probably always connected with ionisation, e.g. the characteristic lines come out in the electrical discharge through the gas.

Regarded simply as obstacles, the molecules must contribute a term to $\mu^2 - 1$, which is proportional to N and practically independent of the frequency. The final formula obtained is

$$\mu^2 - 1 = k_1 N + k_2 N/\theta f(p, \theta),$$

where k_1 and k_2 are constants, and $f(p, \theta)$ is a function of p and θ . The function is fully discussed in the paper.

The formula is shown to be capable of accounting for all the known facts connected with the dielectric constant and the refractive index, while the absorption of ultra-violet light and apparent absorption, due to selective reflection in the infra-red, is also explained.

Notwithstanding the very complex and varied facts in air, hydrogen, carbon dioxide, ammonia and sulphur dioxide, complete numerical agreement between the measurements of $K - 1$ and $\mu^2 - 1$, as regards both absolute magnitude and dependence on pressure, temperature and frequency, has been established.

Chemical Society, June 4.—Dr. W. H. Perkin, sen., F.R.S., vice-president, in the chair.—The following papers were read:—Formation of an anhydride of camphoryloxime, by Dr. **Lowry**. This anhydride is formed when nitro-camphor is boiled with concentrated hydrochloric acid.—Mutarotation of glucose, as influenced by acids, bases and salts, by Dr. **Lowry**. The mutarotation of glucose is greatly accelerated by the presence of alkalis, less so by acids, and is not influenced by the presence of salts.—The solubility of dynamic isomerides, by Dr. **Lowry**. It is shown that in some cases the determination of solubility may be applied to the study of dynamic isomerides, thus the solubility of *pseudo*- β -bromonitrocamphor in benzene at 10° increases from 2.3 to 9.3 per cent., whilst a mixture of this with its isomeride dissolves to the extent of 14 per cent.—The rusting of iron, by Dr. **Moody**. It is stated that the rusting of iron is brought about by the initial production of ferrous carbonate by the action of atmospheric carbon dioxide on the metal, this salt being subsequently oxidised. The non-production of rust in presence of agents which destroy hydrogen peroxide is regarded as due, not

as Dunstan suggested, to the destruction of hydrogen peroxide, but to the insolubility of carbon dioxide in solutions of these substances. In the discussion it was pointed out that the presence of impurities in the iron or in the reagents employed would materially affect the production of rust by inducing electrolytic changes, and that Dunstan had already pointed out that carbon dioxide exercised an accelerating influence in the production of iron rust.—Iminoethers corresponding with ortho-substituted benzenoid amides, by G. D. **Lander** and F. T. **Jewson**. The authors find that they get better yields of iminoethers by alkylation in an ethereal solution than in an alcoholic one, but even there nitriles are formed. They also find that whilst *o*-toluamide gives a yield of only 13.6 per cent., *p*-toluamide gives 70 per cent. of iminoether.—The hydrolysis of ethyl mandelate by lipase, by H. D. **Dakin**. It is shown that *i*-ethyl mandelate is unequally hydrolysed by this enzyme, the product being *d*-mandelic acid.—Isomeric change in benzene derivatives. The conditions influencing the interchange of halogen and hydroxyl in benzene diazonium hydroxides, by Dr. **Orton**.—The synthesis of *acy*-trimethylglutaric acid and its derivatives, by Dr. W. H. **Perkin**, jun., and Miss A. E. **Smith**.—Hexamethylenecarboxylic acid and the *cis*- and *trans*-modifications of hexamethylenetetracarboxylic acid, by Messrs. **Gregory** and **Perkin**.—The bases contained in Scottish shale oil, part ii., by Messrs. **Garrett** and **Smythe**.—A direct method for determining latent heat of evaporation, by Dr. J. Campbell **Brown**. The weight of liquid evaporated by a determinate amount of heat, applied at the boiling temperature of the substance, is determined in a special apparatus.—The four isomeric hydrindamine-*d*-chlorocamphorsulphonates and isomeric compounds of the type NR_2R_3 , by Dr. **Kipping**. The isolation of the isomeric hydrindamine salts referred to in the previous paper affords conclusive evidence of the occurrence of isomerism among quinquivalent nitrogen compounds of this type. The author accounts for this isomerism by the assumption that the five valencies of the nitrogen atom are directed from the centre to the angles of a square pyramid.

PARIS.

Academy of Sciences, June 8.—M. Albert Gaudry in the chair.—On a new general relation between electromotive forces of saline solutions, by M. **Berthelot**. If an element formed by two saline solutions separated by a porous partition A and B has an electromotive force E , the element A+AB, formed by the two solutions A and AB, with electromotive force ϵ_1 , and the element B and AB, with electromotive force ϵ_2 , then the relation $E = \epsilon_1 + \epsilon_2$ is found to hold good. The relation concerning the union of acids and bases, established by earlier experimenters, is a corollary to this more general case.—The formation of alcohol in the fermentation of plant juices containing sugar by M. Armand **Gautier**. An attempt to distinguish analytically between a naturally fermented wine and a liquid artificially fortified with alcohol. Attention was paid especially to the various forms in which nitrogen compounds were present; estimations of glycerol and acidity were also made. It was found that the best characteristics of a really fermented liquid were the amount of volatile acid and the complete absence of ammoniacal nitrogen.—On the propagation of waves in a perfectly elastic medium affected by finite deformations, by M. P. **Duhem**.—Prof. Lorentz was nominated a correspondant for the section of physics in the place of M. Amagat.—On the results obtained by cannonading against hail storms, by M. E. **Vidal**.—On the integrals of the equation $s = f(x, y, z, p, q)$, by M. E. **Goursat**.—On differential equations of the third order which admit of a continuous group of transformations, by M. A. **Boulangier**.—The motion of a solid in a gaseous medium, by M. L. **Jacob**.—An examination of the conditions which determine the sign and the magnitude of electrical osmosis and of electrification by contact, by M. Jean **Perrin**. Electrical osmosis is intense only for ionising liquids; thus a marked effect was produced with water, methyl, ethyl, and propyl alcohols, acetone and nitrobenzene, but was absent with benzene, ether and turpentine.—On the external thermal conductivity of silver wires plunged in water, by M. E. **Ragovsky**. The wires were heated electrically, and a steady current of water passed at a measured rate through the tube surrounding the wire, observations being made

when a stationary state was attained.—Hypothesis on the nature of radio-active bodies, by M. Fillipo **Re**. An extension of the nebular theory to the formation of atoms. It follows from the hypothesis that radio-active bodies should possess a high atomic weight, and should give out energy owing to the contraction of their atoms.—Dissociation curves, by M. A. **Bouzat**. From an examination of thirty-five experimental results the following law is deduced:—in a group of univariant systems in which a solid body gives rise by dissociation to another solid body and a gas, the ratio of the temperatures corresponding to a given dissociation pressure in any two systems of the group is constant, whatever the pressure may be. The law has been verified for a range of temperature from 238° to 1065° (absolute), and of pressures from 300mm. to 1600mm.—On the action of arsenic on copper, by M. Albert **Granger**. When copper is heated with arsenic in an inert gas at 440° for a sufficient length of time, a definite crystallised copper arsenide is produced, having the composition Cu_3As_2 . Phosphorus gives a corresponding compound.—On the qualitative and quantitative analysis of osmium alloys, by MM. **Leidié** and **Quennessen**. The alloy is attacked by fused caustic soda and sodium peroxide, the osmium and ruthenium separated in the form of the volatile peroxides, and the iridium as the double nitrite of iridium and sodium.—On the nutrition of plants deprived of their cotyledons, by M. G. **André**. The assimilation of organic material is lessened by the removal of the cotyledons, but the ratio of phosphoric acid to nitrogen is practically unaffected.—On the mechanism of the saccharification of the mannans of *corrozo* by the seminease of lucerne, by MM. Ed. **Bourquelot** and H. **Hérissey**. The extract from *Phytelephas macrocarpa* contains a soluble ferment the hydrolysing action of which is complementary to that of seminease.—Research on indoxyl in certain pathological urines, by M. Julius **Gnezdá**.—The mechanism of the emission of larvæ in the female of the European lobster, by MM. **Fabre-Domergue** and E. **Biétrix**.—On the iron ore of Troitsk, by MM. L. **Duparc** and L. **Mrazec**.—Castration in man, and the modifications which result from it, by M. Eug. **Pittard**.—On the cinematography of barometric movements, by M. P. **Garrigou-Lagrange**. A series of charts of isobars, mapped out for equal intervals of time, has been studied by means of the cinematograph. The examination of the American charts has clearly shown that, in spite of their apparent complication in detail, there are in reality but two general movements of the atmosphere. These two movements have the effect of alternately opening and closing the two routes followed by American depressions. A study of European charts leads to similar conclusions, although the regularity is less marked than in America.—On the conflagration of balloons during landing, by M. **de Fonvielle**. The disaster of the *Pannewitz* was probably caused by the electrification of the balloon giving rise to a spark.

GÖTTINGEN

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part ii. for 1903, contains the following memoirs communicated to the Society:—

February 21.—E. **Riecke**: Contributions to the theory of atmospheric electricity, iii., on the mass of the ions contained in the air.

F. **Krüger**: The theory of polarisation-capacity.

March 7.—W. **Nernst**: The determination of molecular weights at very high temperatures.

F. **Bernstein**: On the associated domains (Hilbert's *Klassenkörper*) of an algebraical domain (*Zahlkörper*).

E. **Riecke**: Contributions to the theory of atmospheric electricity, iv., on the "adsorption" of ions at the earth's surface.

DIARY OF SOCIETIES.

THURSDAY, JUNE 18.

ROYAL SOCIETY, at 4.30.—(1) Surface Flow in Crystalline Solids under Mechanical Disturbance; (2) The Effects of Heat and of Solvents on Thin Films of Metal: G. Beilby.—The Forces Acting on a Charged Electric Condenser Moving through Space: Prof. Trouton, F.R.S., and H. R. Noble.—On the Discharge of Electricity from Hot Platinum: Dr. H. A. Wilson.—The Bionomics of *Convoluta Roscoffensis*, with Special Reference to its Green Cells: Dr. F. W. Gamble and F. W. Keeble.—New Investigations into the Reduction

Phenomena of Animals and Plants; Preliminary Communication: Prof. J. B. Farmer, F.R.S., and J. E. S. Moore.—The Action of Choline, Neurine, Muscarine and Betaine on Isolated Nerve, and on the Excised Heart: Dr. A. D. Waller, F.R.S., and Miss S. C. M. Sowton.—The Physiological Action of Betaine Extracted from Raw Beet Sugar: Dr. A. D. Waller, F.R.S., and Dr. R. H. Aders Plimmer.—On the Physiological Action of the Poison of the Hydrophidæ; Part II. Action on the Circulatory, Respiratory and Nervous Systems: Dr. L. Rogers.—The Spectra of Neon, Krypton and Xenon: E. C. C. Baly.—And other Papers.

LINNEAN SOCIETY, at 8.—Descriptions of New Chinese Plants: S. T. Dunn.—On the Life-history of a New Indian Species of *Monophlebus*: E. P. Stebbing.—On the Anatomy of Leaves of British Grasses: L. Lewton-Brain.—Scottish Freshwater Plankton.

FRIDAY, JUNE 19.

ROYAL INSTITUTION, at 9.—Radium: Prof. Pierre Curie (in French).

MONDAY, JUNE 22.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Explorations in Bolivia: Dr. Evans.

WEDNESDAY, JUNE 24.

GEOLOGICAL SOCIETY, at 8.—On a Transported Mass of Ampthill Clay in the Boulder-clay at Biggleswade: Henry Home.—The Rhaetic and Lower Lias of Sedbury Cliff, near Chepstow: L. Richardson.—Notes on the Lowest Beds of the Lower Lias at Sedbury Cliff: A. Vaughan.

THURSDAY, JUNE 25.

UNIVERSITY COLLEGE MATHEMATICAL SOCIETY, at 5.30.—Some Present Aims and Prospects of Mathematical Research: E. T. Whittaker.

FRIDAY, JUNE 26.

PHYSICAL SOCIETY, at 5. (University of London, South Kensington).—(1) Electrical Effects of Light upon Green Leaves; (2) Blaze-Currents, (a) of a Vegetable Tissue, (b) of an Animal Tissue; (3) Quantitative Estimation of Chloroform Vapour in Air by (a) Oil Absorption, (b) Density: Dr. Waller.—The Temperature Limits of Nerve-Action in Cold-blooded and in Warm-blooded Animals: Dr. Alcock.—(1) On the Movement of Unionised Bodies in Solution in an Electric Field; (2) On the Passage of Nervous Impulses through the Central Nervous System: Dr. Hardy.

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